

# The Leap from Teacher to Teacher-Scholar: The Quest for Research in Non-Traditional Fields

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## Abstract

*With the national trend toward decreasing state allocations, higher education institutions have been forced to be entrepreneurial to survive, and search for alternative means of funding through external agents. Many technology professors are finding themselves in a situation in which their top mission of teaching must be transformed to a teacher-scholar model. Through use-inspired basic research, which is the marriage between traditional basic university research and applied research, technology professors must strive to link their research findings directly to their coursework. They must be proactive in the search for external funding, not only to foster the culture of the academic enterprise, but also to become better teachers. This can be accomplished through federal grants, industry collaboration, and technology transfer.*

*The academic enterprise model of "academic capitalism" (Slaughter & Leslie, 1997) brings with it several implications: (1) social stratification on a global, national, institutional, and individual level, (2) industry collaboration, (3) the priority shift from instruction to research, and (4) a new higher education research model. The culture of academic capitalism impacts professors in non-traditional fields behaviorally through individual challenges in stratification, autonomy, and meritocracy. It also impacts the manner in which faculty must now work. Whether this is an opportunity or a threat to the academic success of the technology professors remains to be seen.*

*According to Donald E. Stokes (1997), former Dean at Princeton University, technology that stagnates in the lab offers almost no economic benefits. Innovations of technology require scientific methods applied to industrial practices. This paper will draw from two arenas of higher education and technology: "academic capitalism" and "Pasteur's quadrant." (Stokes, 1997).*

## Trends in higher education

During the last 50 years there have been many policy shifts in higher education. The most significant shift in the United States is the decrease of state allocation since the 1980's (Heller, 2002) which left the academe with the charge of finding new way of doing business while facing dwindling resources. This national trend has resulted in higher education institutions, especially public universities, being forced to be entrepreneurial to survive. These higher education institutions are searching for alternative means of funding through external agents, and have moved from "an agency model to an enterprise model of investment" (Crow, 2003). Many Research I universities have looked toward technology transfer, industrial collaboration, and federal grants, as a means of revenue production.

This organizational survival and adaptation behavior can be explained by the resource dependency theory, (Pfeffer & Salancik, 1978) which is an organizational theory that justifies changes in academic labor. It is particularly valuable in informing our understanding of higher education organizations in the midst of budget cuts and strategic reorganization. The resource dependency theory, which is a power and conflict theory, is applied during times of fiscal crisis in higher education. It basically maintains that resources drive organizational behavior. In other words, as Leslie (Slaughter & Leslie, 1997) contends, "He who pays the piper calls the tune." In this model the behavior of the internal actors are tied to the external actors, which results in the direct dependence upon external funding agents. Organizations are directly and indirectly impacted by resource allo-

cation in two ways: (1) “Relative magnitude,” which relates to the number of sources providing funding, and (2) “Criticality,” which is the rate at which the organization can function without the funding.

In recent years the money has been available. Federal support has not only maintained current levels, but for the first time in history a United States president requested a research and development budget of more than \$100 billion. President George W. Bush allocated \$112 billion in 2002 – an increase of eight percent from the previous year; however, with the federal budget going from a surplus of \$236 billion to an estimated deficit of \$455 billion in fiscal 2003, President Bush requested \$900 million less than previously authorized. Even with this cut, the amount requested for The National Science Foundation (NSF) in 2004 comes to \$5.5 billion (Walsh, 2003). Industry funding for academic research has continued to grow as well, increasing from \$1.4 billion in 1994 to \$2.2 billion in 2001. Industry money now accounts for nearly eight percent of academic research funds (Grose, 2003).

Many technology professors, especially those on a tenure-track, are finding themselves in a situation in which their top mission of teaching must be transformed to a teacher-scholar model. Through use-inspired basic research, which is the marriage between traditional basic university research and applied research, technology professors are faced with the mandate to link their research findings directly to their coursework. Those who successfully foster the new culture of the academic enterprise are proactive in the search for external funding.

The mission in this new academic culture, especially for faculty in non-traditional fields, such as technology, is to provide the linkages between technology and industry. According to Donald E. Stokes (1997) former Dean at Princeton University, technology that stagnates in the lab offers almost no economic benefits. Innovations of technology require scientific methods applied to industrial practices.

This paper makes certain assumptions about higher education and faculty. The knowledge and skill sets contributing to the economy, which are retained by the labor force of the university – the faculty, are called higher education’s human capi-

tal. Another assumption is that the professional norm of altruism toward the good of both society and the higher education institution is prevalent in the traditional academe. Public service and altruism have traditionally been traits of higher education faculty; however, with the advent of academic capitalism, there is a trend to justify participation in entrepreneurial activities as a means to contribute to society and the university. The authors will examine the birth of the “quiet revolution” of academic capitalism<sup>1</sup> and the research model shift to Pasteur’s quadrant.

### Definitions

In order to understand the leap from teacher to teacher-scholar, several terms need further clarification: (1) teacher-scholar, (2) teaching, (3) scholarship, and (4) non-traditional fields.

#### *Teacher-Scholar*

The concept and therefore definition of teacher-scholar must be based upon a specific definition of good teaching and a comprehensive definition of scholarship.

#### *Teaching*

Teaching involves the dissemination of knowledge through effective communication. This requires engaging students in the learning process through a variety of instructional methods. Good teachers demonstrate a commitment to excellence along with the capacity for criticism and self-examination.

#### *Scholarship*

According to Boyer (1990) scholarship has many forms including: (1) Scholarship of Discovery, (2) Scholarship of Teaching, (3) Scholarship of Integration, and (4) Scholarship of Application. Scholarly investigation in all of the disciplines is central to the work of higher education and contributes to both the addition of new knowledge and the intellectual climate of the university.

Scholarship of Discovery involves the traditional research model involving the commitment to create and disseminate new knowledge, contributing to the knowledge base of one’s field. This has traditionally been model of scholarship accepted for academic scientists.

Scholarship of Teaching is the pedagogy of teaching excellence, knowledge creation, and acquisition. It can involve finding ways that stu-

dents learn, as well as assessment of the methods that are used. Teaching as a form of scholarship can both educate and entice future scholars. Good teaching implies that the faculty/teachers are good learners and inspired teaching can complement good scholarship (Boyer, 1990).

Scholarship of Integration utilizes the creation of coherent patterns of new knowledge by synthesizing and making connections across disciplines. Integration may result in the examination of knowledge, technologies or applications. It may lead to the refinement and combination of information in related fields. Cross-disciplinary programs like “Biocomplexity in Environment” and “Nanoscale Science” are enjoying large increases while core programs like engineering are slated to grow at less than the rate of inflation (Hall, 2003). Boyer (1990) states that integration must be “serious, disciplined work that seeks to interpret, draw together, and bring new insight to bear on original research.” Scholars engaged in integration seek to find out what the findings mean through the power of critical analysis and interpretation. Boyer (1990) further argues that “today, interdisciplinary and integrative studies, only on the edges of academic life, are moving toward the center, responding both to new intellectual questions and to pressing human problems.”

Scholarship of Application provides the opportunity to bridge the gap between theory and practice. It involves practical problem identification and resolution through research and action. Many technology professors are particularly suited for this aspect of scholarship. Within the academic community, this approach has sometimes been analogous with service, which has previously been rejected as serious scholarship. In this area it is important to draw a clear line between citizenship and scholarship-related activities. Boyer (1990) argues that “to be considered scholarship, service activities must be tied directly to one’s special field of knowledge and relate to, and flow directly out of, this professional activity.”

#### *Non-traditional fields*

Traditional academic areas, the sciences, pharmacy, and medicine have well defined paths toward research. Professors in these areas began their research focus as graduate students or even undergraduate students. Professors in non-traditional academic fields may have spent years in

industry prior to making the move to academia, so their research path is less defined. These professors have concentrated on being good teachers rather than good scholars. Some fields, including engineering graphics, have lent themselves to more of a supporting role to other academic areas include engineering, architecture, and interior design. Engineering graphics departments and professors across the country have also been absorbed into other departments, such as Civil, Mechanical, and Environmental Engineering, & Geodetic Sciences.

### **Implications of academic capitalism**

Rhoades and Slaughter (1997) argue in their book *Academic Capitalism, Managed Professionals, and Supply-Side Higher Education* that one should follow the money to see where the priorities are in the institution. The concept of academic capitalism was built upon the foundation of the political economy model. Those colleges and universities who have been successful in developing ties with industry, increasing technology transfer, and moving their research to use-inspired, as discussed in *Pasteur’s Quadrant*, have brought prestige to their institutions, as well as resources.

Academic capitalism brings with it many implications for higher education on a global, national, and institutional level. Social stratification, industry collaboration, a shift from instruction to research, and the introduction of a new research model, all affect the behavior of the faculty and the way they do work. Non-traditional faculty behavior is affected by changes in social stratification, autonomy, and meritocracy. They have become “managed professionals,” (Rhoades, 1998) are subjected to the “publish or perish” mandate, and have a changing role in the reallocation of responsibilities.

### **Social stratification**

Because the United States competes on a global market, higher education is a social stratification tool for the “techno-science regime” (Slaughter, 1998). Largely because of academic capitalism, universities have status in the global economy (Etzkowitz & Leydesdorff, 1997). The United States is not the only country challenged with the academic enterprise model. Findings in other English-speaking countries in Europe

consist of clashing faculty and administrative values, resource diversity, and the trend toward entrepreneurial activity. Just as in the United States, the United Kingdom's external funding is the key to survival with science, engineering and professional schools evolving into the pivotal point of higher education (Gibbons, et al., 1994). Australia also corresponds to the entrepreneurial trend in the UK with higher education institutions and faculty engaged in academic capitalism (Buchbinder & Rajagopal, 1995; Marginson, 1993; Marginson, 1995). Canada also is confronted with the decrease in government resource allocation, and has moved toward marketization (Buchbinder & Newson, 1990; Buchbinder & Rajagopal, 1993; Buchbinder & Rajagopal, 1995; Gonzales, Niemeier & Navrotsky, 2000).

Research in the techno-science area is fast becoming the top research strategy. Whether that is interpreted by administrators to mean the quest for external funding of grants and contracts from the partnerships with industry and government, or the concentration on graduate education as the principal role of Research I universities, remains to be seen.

On a national level, external resources must be increased to balance the decrease in state funding. The examination of the newly formed stratification of access and attainment of higher education and the sociological impact on a national level can be perceived as an opportunity or a threat. Indeed, the authors of the paper suggest that the loosely coupled relationship between the leadership of higher education, our state legislature, private industry, and the federal government, has evolved into the financial turmoil we see today.

Trow (1970) argues that resources stratify institutions. Power reigns with those closer to the money (Rhoades & Slaughter, 1997). Prestige also follows those institutions, units and faculty members who are closest to the money (Rhoades & Slaughter, 1997). Research monies are awarded to those fields closest to the market. Salaries and state resources benefit the departments closest to the market, who have many graduate students and grant monies. Feminized fields, such as social science, humanities, and women's studies, receive the least of the state resources (Bellas, 1997). Computer science, sciences, engineering and technology receive the most (Bellas, 1997).

### **Industry collaboration**

By the mid-1980s the university faculty and higher education institutions had interconnected with the industrial world through market liaisons with business and industry. This shook the very foundation of the relationship professors traditionally held with society. The focus of the academe began to shift toward external funding and entrepreneurial issues. The past 20 years have seen the rise of partnerships between academia and industry to such a level that academic-industrial ties have become almost common place.

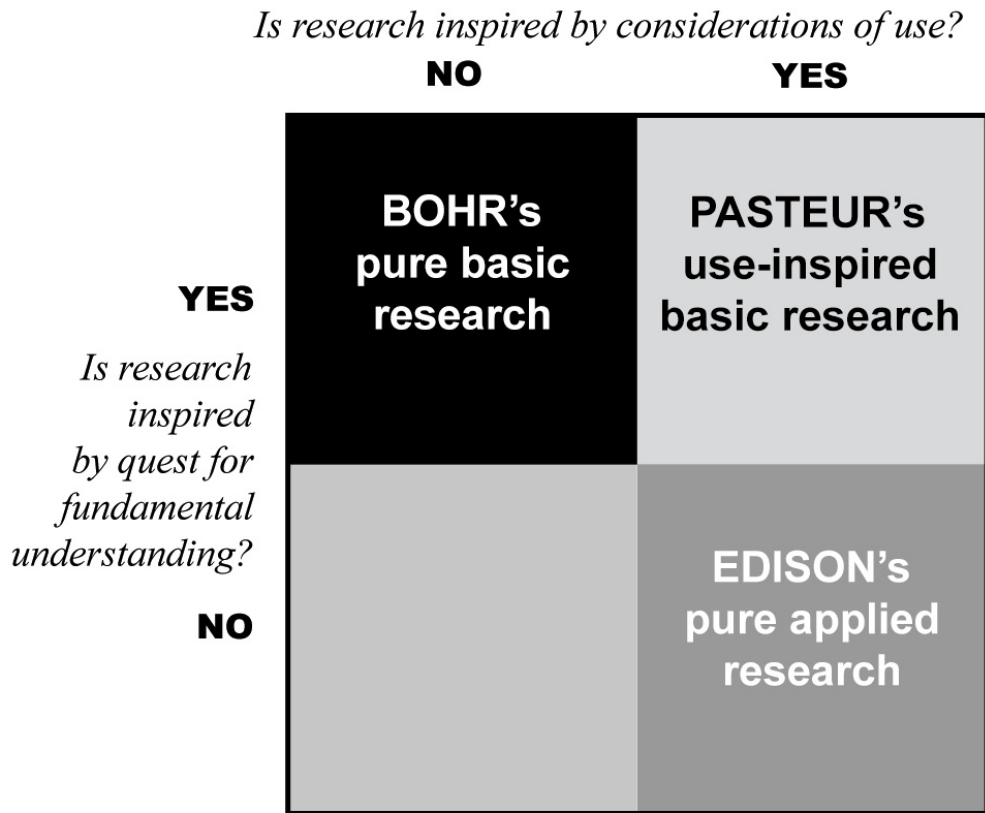
As state and federal government revenues diminish as an American higher education financial resource, the academe is being restratified. Industrial partnerships and the marketing of business and educational services help offshoot the financial repercussions of this new direction.<sup>23</sup> Corporate ties can provide huge sources of revenue for universities as well as opportunities for researchers and scholars. Collaboration has been enhanced by the 1980 Bay-Dole Act, which gave universities the right to patent intellectual property that resulted from taxpayer funding. Subsequent laws including tax breaks to companies that fund research have furthered the collaboration effort. Expanding technology transfer offices and the rise in invention disclosures, new patents, licenses, and options show that the commercialization trend in academia is a growth industry.

### **The shift from instruction to research**

As financial shifts push higher education into academic capitalism, faculty may find that moving closer to the market is a double-edged sword. Rhoades and Slaughter (1997) argue that federal policy and supply-side institutional resource allocation at public universities have resulted in the economic function of higher education often taking priority over the educational function. Cost center priorities have shifted from instruction to research.

Universities are not simply storehouses of knowledge nor are they simply degree-granting factories. They must unite scholarship with teaching. According to the Academic Council at Saskatchewan University (2000), scholarship involves the discovery of new knowledge, its integration and synthesis, and its application to

## SCIENTIFIC RESEARCH QUADRANT MODEL



new or persistent problems. Coate et al. (2001) argues that it is clear that values accorded to teaching and research have begun to shift. Many universities where teaching has been highly valued may be changing due to external pressure to generate income and status from research. Independent relationships between teaching and research are complicated by the difficulty of establishing clear boundaries between teaching and research. Business ideology is often adverse to the academic climate, because faculty is focused on research and faculty must be internally motivated (Slaughter & Leslie, 1997).

### Introduction of a new higher education research model

The nonchalant societal attitude of the 1960s and 1970s had an influence on the role of science in product research and development in our society. Basic research, which is curiosity-driven, was the norm of the academe. Eventually, basic and

applied research merged to form "Pasteur's quadrant" in which "knowledge is inherently entrepreneurial" (Gibbons, et al., 1994; Stokes, 1997).

Because organizations seek stability, financial crisis results in "organizational turbulence" (Slaughter & Leslie, 1997). Organizational behavior is defined by financial decisions that are made internally. When organizations are faced with a decrease in crucial funding, they will pursue other creative avenues of gaining more resources. In order to do this, the focus will be toward science and technology and not basic research, according to Slaughter and Leslie (1997). Basic research and applied research do not have to be the antithesis of each other. Stokes (1997) conceptualized that applied research can also be categorized as basic.

Stokes (1997) visualized this concept as a quadrant framework of scientific research utilizing a square divided equally into four cells. The first cell consists of Niels Bohr's highly abstract quest of a model atomic structure, which emulates

the nineteenth century German perspective of pure basic research with no consideration of use.

Pasteur's quadrant – the second cell – evolved as use-inspired basic research. This collection of mixed goals – of probing to understand as well as control, improve, profit, exploit, or alter, sets up the foundation for a collaborative relationship between the working scientist and the sponsor. This is often referred to as “strategic research.”

Thomas Edison's push toward the market with the prospect of marketable electrical lighting is an example of purely applicable research with no pursuit of fundamental philosophical understanding. This quadrant configures the third cell and is often referred to as “tactical research” (Stokes, 1997). It meets a need of society.

The fourth quadrant, which is not an empty cell, but rather an exploration into specific phenomena, is neither inspired by the fundamental quest of understanding, or by the consideration of use. Research in this area often is focused on only developing the skills of the investigator, or it may be similar to the systematic specific findings in *Peterson's Guide to the Birds of North America* (Stokes, 1997).

Pasteur's quadrant is the approach to research that the authors believe is most beneficial for the technology professor, as it fits most comfortably with prospective sponsored projects in technology. What is important about this approach to research is that universities consider the perspective of Pasteur's quadrant to be basic research, yet the government views it as applied research. It then becomes a win-win situation.

### Faculty behavior

“Faculty are a subset of professionals, although in some ways they are the paramount professionals, because they have monopolies on advanced degrees and train and credential all other professionals,” Slaughter and Leslie (1997) argue. Faculty engaging in marketlike behavior by competing for external resources and engaging in production are referred to as “state-subsidized entrepreneurs” or “academic capitalists.”

As faculty members buy into academic capitalism, they become closer to the money and hence more stratified. The benefits of academic capitalism for the faculty are multi-faceted. When faculty members are partnered with external tech-

no-science expertise, they gain prestige and salary negotiation power through their direct relationship with the market and their own increasing marketability. Faculty labor can be perceived by external resource leaders as possible developers of intellectual property, which could easily be converted to marketable products or commodities.

Slaughter and Leslie (1997) have found that research universities funded by the state, have evolved into communities saturated with dichotomies. “... faculty and professional staff expend their human capital stocks increasingly in competitive situations,” according to the authors. Faculty and institutions lose some of their autonomy with a shift toward the market, however. Research and development policies are formulated to replace basic research – “professors' curiosity-driven research” – by more applied research, which is intertwined with the economic growth (Slaughter & Leslie, 1997).

Faculty meritocracy may begin to be based on positioning closer to the market. Tenure-track professors will not only have to “publish or perish,” but their merit will be formed by the degree of their involvement in higher education entrepreneurial activities.

### Other implications

There are several other implications for professional practice that can be drawn from this scholarly work for the faculty and administration. One implication is the possible decrease in undergraduate education focus in Research I universities, due to the allocation of resources for research and graduate studies. The academic enterprise affects non-tenure track faculty, such as lecturers and faculty associates, who are not responsible for implementing academic capitalism. In order for the tenure-track professors to search for and participate in sponsored projects and scholarship, non-tenure track faculty will be left with the majority of the undergraduate teaching load.

Another implication for faculty and administrators is the redistribution of power in the academe through the reallocation of responsibilities to obtain and spend external funding; thus, resulting in research “paying its own way” and universities becoming less dependent upon government monies.

### Why teaching isn't enough

Why has the top mission of teaching to teacher-scholar changed in non-traditional fields ... or has it? Teaching has been the mission of many universities; however, the reward structure for tenure and promotion is more tightly linked to scholarship and research. Good teaching alone has rarely been the ultimate criteria for promotion at the university level. Recently, the concept of teacher-scholar model has been gaining popularity.

The times in the higher education arena have changed for the technology professors holding their teaching responsibility above their service and scholarship. No longer do the professors have the luxury of concentrating most of their daily efforts on their curriculum and course content. Publish or perish. This is not a new mandate for many colleges, but it comes with a different twist. Because of the horrific state allocation, money must follow.

In order to survive, professors in fields that have not traditionally had a strong interest or defined research mode must become teacher-scholars. Many of these professors have established themselves as good teachers; however, sometimes the scholarship has been more elusive. Gonzales et al. (2000) argue that institutions need to rethink the traditional ideas about faculty identity and support. In "The New Generation of American Scholars," they suggest that many scholars have engaged in interdisciplinary work involving the integration of existing knowledge, or the creation of new knowledge. Researchers have established horizontal linkages with faculty in other departments and institutions. Teacher-scholars in engineering graphics and technology who often teach service courses and applied courses have a rich variety of skills to offer in a cross-discipline world.

### Conclusion

Politics and economics are unpredictable and irrational; therefore, academic capitalism is more complicated than theoretical models would lead us to believe. There is an on-going trend for universities to rethink resource-generating habits of the past and engage in revenue-generating activities. This trend has produced funding, which invariably favors activities of academic capitalism, instead of

those of teaching.

Decrease in state allocation changes faculty behavior and has resulted in a shift in the nature of how faculty works. Professors in non-traditional academic fields are aspiring to be teacher-scholars, not only to increase funding, but also to enhance the quality of their teaching. As long as funding allows them to sustain or advance their status at the university, as well as enable them to have freedom with discretionary monies, faculty will be willing to be continually engaged in academic capitalism.

Higher education must become more efficient, self-supporting, and innovative with resources. There is a behavioral interconnection between the faculty and external agents, which can disrupt the entire dynamics of the academe's contract with society, if it is not kept in check. The availability of corporate resources will cause a shift from liberal arts thinking to the business mindset of profit through use-inspired research. Despite the downfalls, the authors believe that academic capitalism and Pasteur's quadrant are undeniable solutions for continuing research funding, developing prestige in higher education, and making the leap from teacher to teacher-scholar.

### Sponsored Projects: Eight tips for acquiring funding

Funding can be obtained from government grants, private and corporate foundations, or industry.

1. A good proposal begins with a good idea. It must be well expressed with a clear methodology for pursuing the idea, evaluating the findings and disseminating the information to those who will benefit from the project. It helps to show sustainability, how the program will be carried out or built on after the funds have run out. Attempt to show the impact your project will have on people, why the taxpayers dollars should be used for your project.
2. The easiest way to get funded is to be funded; however, writing and submitting grants show that you are trying to fund your ideas. Make your proposal match the Request for Proposal (RFP).
3. Develop some strategies for determining possible funding sources. Read all announce-

Useful Funding Sources	
National Science Foundation (NSF)	<a href="http://www.nsf.gov">http://www.nsf.gov</a>
Illinois Researcher Information Service (IRIS) <i>your university must be a subscriber</i>	<a href="http://gateway.library.uiuc.edu/iris/">http://gateway.library.uiuc.edu/iris/</a>
Grants NET Helps you search for training in the sciences and undergraduate science education	<a href="http://www.grantsnet.org">http://www.grantsnet.org</a>
National Endowment for the Humanities	<a href="http://www.neh.gov">http://www.neh.gov</a>
National Association of International Educators Promotes the exchange of students and scholars to and from the United States	<a href="http://www.nafsa.org">http://www.nafsa.org</a>
United States Department of Education	<a href="http://www.ed.gov">http://www.ed.gov</a>
W. K. Kellogg Foundation	<a href="http://www.wkkf.org">http://www.wkkf.org</a>
Foundations-on-line	<a href="http://wwwFOUNDATIONS.org">http://wwwFOUNDATIONS.org</a>
Foundation Center	<a href="http://www.foundationcenter.com">http://www.foundationcenter.com</a>

ments very carefully, and determine where your project fits. Pay close attention to the goal of the program, who is eligible to apply, deadlines, target dates, and other special requirements.

4. Talk with the Program Officer at your university about your proposed project and specific requirements or limitations.
5. Talk to others who have been funded by this agency.
6. Examine successful proposals and determine why they were successful.
7. Offer to serve as a reviewer.
8. Find a mentor on your campus or in your field who can help you develop your skills.

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